Input device for control signals for controlling the movement of an object represented on a display device and graphic display having said input device

The present invention refers to an input device for control signals for controlling the movement of an object represented on a display device and to a display device, the representation of which is controlled by a control signal input device.

Control signal input devices are known, e.g., in the form of mouse devices. Using such input devices one may control and influence, for example, the cursor movement on a monitor or - in case of a user program - for example, the representation on a display device, e.g. a monitor. It would be advantageous in a plurality of applications to have representation-specific input devices available that, due to their structure, make it easier for a user to readily control representations, in particular stereographic representations, on a display device, e.g. a monitor.

From US-A-5 734 370, an input device for a display device is known, with which an object may be displaced on the display device. The known input device comprises a rod that can be pivoted within the housing of the input device about two mutually parallel axes and can be displaced about its longitudinal axis. The known input device serves to control a virtual pool application. Further, from US-A-5 729 249, a cubic input device is known the side surfaces of which have sensitive regions or actuating elements for manipulating an object displayed on a display device. This known input device is disadvantageous in that the arrangement and orientation of its actuating elements do not correspond to the directions in which the object can be moved by the actuating elements or in which the representation can be manipulated.

It is the object of the present invention to provide a control signal input device of the type mentioned above, as well as a graphic representation using this input device, allowing for a more user-friendly handling.

To solve the object, the invention provides a control signal input device for a display device, the input device being provided with

- a housing,

- three control signal generating devices for generating first control signals to the display device,

- three mutually orthogonal actuating elements, each being supported at or in the housing for linear displacement along one of three orthogonal spatial axes and projecting outward beyond the housing within at least one of two opposite portions of the housing, respectively, each actuating element respectively cooperating with a different one of the control signal generating devices, and wherein, in dependence on the displacement position of the actuating elements, the control signal generating devices generate the first control signals for displacement of the object on the display device along three directions corresponding to the spatial axes of the housing on the display device, and

- a position detection sensor arrangement provided in or at the housing, the position detection arrangement sensing the orientation and/or the position of the housing and generating a corresponding control signal to the display device for orienting the object on the display device according to the orientation and position of the housing.

In a variant, the present input device comprises

- a housing,

- three control signal generating devices for generating first control signals to the display device,

- three pairs of actuating elements, both actuating elements in each pair being arranged at different, in particular opposite, portions of the housing lying on a respective one of three orthogonal spatial axes extending through the housing, each pair of actuating elements respectively cooperating with a different one of the control signal generating devices, and wherein, in dependence on the actuating condition (e.g., actuating time and/or actuating pressure) of the actuating elements, the control signal generating devices generate the first control signals for displacement of the object on the display device along three directions corresponding to the spatial axes of the housing on the display device, and

- a position detection sensor arrangement provided in or at the housing, the position detection arrangement sensing the orientation and/or the position of the housing and generating a corresponding control signal to the display device for orienting the object on the display device according to the orientation and position of the housing.

A display system of the present invention comprises

- a display device and

- an input device for generating control signals for displacing and/or orienting and/or positioning the object to be represented and/or displacing the sectional views along the axes, the input device being configured according to one of the previously described variants.

In the present input device, actuating elements, which when actuated generate first control signals for controlling the display device, are arranged on the three mutually orthogonal spatial axes extending through the housing. These actuating elements project from the housing at at least three locations, preferably at six locations. These actuating elements are either linear displacement elements such as rods or the like, or actuating element pairs such as feelers/key switches located in pairs within opposite portions of the houses on the three orthogonal axes. Such a control signal input device is particularly useful for three-dimensionally influencing a stereographic representation on a display or for controlling a perspective representation on a display along three axes corresponding to the perspective or for displacing, positioning or orienting an object to be represented on the display. "Displacement of the object" should be understood in a broad sense in the context of this invention. Generally, it refers to a manipulation of the object representation in the direction of the three spatial axes. For example, the present input device allows to comfortably "pass" through bodies displayed on the display device along three axes so as to have, e.g., the different sectional views along the three axes displayed. In the present case, the sectional views are the object and are "displaced" when passing through the body. This may be advantageous, for example, in the field of medicine and in planning surgery so as to pass through a body part such as the head along several axes, thereby making it "transparent" to the doctor or surgeon. A further alternative of the "displacement of the object" is moving the object within its environment represented on the display device.

The exact positional orientation of the input device relative to the representation on the display such that the three axes on which the actuating elements of the input device are located correspond to the three axes of the representation on the display, is realized in the present invention by providing the input device, e.g., with an inertia position and orientation detector arrangement or an orientation and/or position detector arrangement. Such a sensor arrangement

should be sensitive about the three spatial axes. One additional such sensor thus guarantees that the change of representation on the display expected by the user can actually take place according to the pivoting of the input device. Through this sensor, the input device is quasi coupled to the representation on the display or vice versa.

The advantage of the present input device is the simplicity of the control of the representation on the display device. Due to the automatic positionally exact orientation of the input device with the representation (object) on the display, the actuation of the actuating elements corresponds to a corresponding change in the representation (object) on the display. Through the coupling of the orientation of the input device and the represented object, the arrangement of the actuating elements at or in the housing of the input device corresponds to the axes along or about which the representation can be manipulated (e.g. displacement of the sectional planes of an object or displacement of the object itself along three orthogonal axes).

The principal idea of the invention is to provide the user with an input device representing a three-dimensional coordinate system. In the simplest form, the input device is a housing through which three orthogonal three displaceable, and possibly rotatable, rods extend that represent the three coordinate axes. By means of a position detector arrangement integrated in the input device, a coordinate system of a three-dimensional application is always maintained synchronous with the orientation of the input device. Thus, a displacement or rotation of the rods results in a displacement or rotation of a graphic object in the corresponding direction. When the input device is held such that the z-axis points upward, for example, the graphic object is also represented with its z axis pointing upward. When the rod corresponding to the z axis is pushed downward, the graphical object also moves downward. When the input device is turned to the right through 90°, the graphical object is also turned to the right through 90°, and a displacement of the z axis rod, now pointing to the

right, results in a displacement of the graphical object to the left or the right. This direct relationship between the manipulation of the input device and the graphical output resulting therefrom, makes using the input device very easy and intuitively comprehensible for the user.

In an advantageous development of the invention, it is further provided that the housing has a parallelepiped shape, in particular a cubic shape, with six side walls and that the actuating elements, when supported at or in the housing for linear displacement, extend from all side walls, the ends of each actuating element projecting from two opposite parallel side walls of the housing. When three pairs of actuating elements, such as three pairs of key switches, are provided, these actuating elements are located at all side walls of the cubic housing. As an alternative, the housing may be spherical. It is also conceivable to give the housing an outer contour that is the same as the outer contour of the object to be represented. For example, the housing has the shape of a human head when such a head is represented on the display. The arrangement of the actuating elements then corresponds to the possible manipulation of the representation of the head on the display.

Through additional actuating elements or by a rotatable or otherwise further movable support of the actuating elements, which may also be arranged on the linearly displaceable actuating elements, for example, it is possible to generate further control signals with the present input device. Additional key switches or other switches could be used, for example, to realize representation functions such as scaling the represented body or object or rotating the same. Eventually, it is also conceivable that such additional actuating elements can be used to realize display functions like a slight tilting of the represented sectional plane about an axis. This application may be of interest in structural technology or teaching.

As a structural embodiment of these additional actuating elements, on e may contemplate rockers or knurled wheels besides key switches and other switches. Generally speaking, the present input device can be equipped with all of the conventional actuating elements known per se from electrical apparatus.

When using displaceable actuating elements projecting from the housing of the input device, such as rods or the like, it is advantageous in terms of comfortable use when the rods are centered and are automatically returned to this centered position (e.g. by restoring springs) when they have been deflected (displaced) from this rest position. By moving the ends of the rods more or less into the housing, the speed of the change of the representation on the display can be controlled. This control function is the same with actuating elements formed as key switches where the speed of the change of the representation is controlled through the actuation time.

The following is a detailed description of the invention with reference to the drawing. In the figures

Fig. 1 illustrates a first embodiment of a display control input device, and

Fig. 2 illustrates a second embodiment of an input device.

Fig. 1 illustrates a display device 10 in the form of a monitor, the screen 12 thereof displaying a body 14. Upon input of the corresponding control instructions by the user, the body 14 can be passed through along the x, y and z axes. In other words, sectional views through the body 14 can be represented that ly in the planes 16, 18 and 20.

The required control signals are inputted via an input device 22 with a cube-shaped housing 24. Accordingly, the housing 24 has three pairs of parallel

side walls 26, 28, 30. Three rods 32, 34, 36 extend through the housing 24 that are orthogonal with respect to each other and protrude from the side surfaces 26, 28, 30 with their ends. The rods 32, 34, 35 are supported at the housing 24 for linear displacement; depending on the displaced position, control signals are generated in signal generating devices 38, 40, 42 associated with the rods, which, in the present case, serve to displace the sectional planes 16, 18, 20 via the drive device 44 of the display device 10. A position and orientation sensor 46 detects the position and orientation of the input device 22. The output signal of this optical, acoustic or electromagnetic sensor 46 is also used to control the representation on the display device 10 through the drive device 44. As a consequence, the coordinate system of the representation on the display device 10 turns with the orientation of the rods 32, 34, 36 of the input device 22 in space (input device coordinate system).

Further functions of the representation, such as the displacement of the object 14 along the three axes of the coordinate system of the representation, can be realized through additional actuating elements 48 located at the housing 24. Through these actuating elements 28, a fine tuning of the position of the respective plane and/or a slight inclination of the representation of the sectional plane about a respective one of the three axes may be effected and/or the representation may be scaled. Through another of these additional actuating elements 48, the above mentioned "coupling" of the input device 22 with the representation on th display 12 can selectively be interrupted or restored, for example. Thus, it is possible, similar to taking a mouse from a pad and placing the mouse on another location, to displace the body 14 on the screen by reciprocating the input device 22 several times. The rotation of the actuating elements 32, 34, 36 may be used, e.g., for the linear fine positioning of the planes 16, 18, 20.

Eventually, the rods 32, 34, 36 are supported for rotation about their longitudinal axis so as to allow fro further display or movement functions of the object on the screen 12 that can be controlled via the input device 22.

Fig. 2 illustrates an alternative embodiment of an input device 22', wherein similar parts of the input device 22' have been given the same reference numerals as in Fig. 1. The input device 22' differs from the input device 22 of Fig. 1 in that it further comprises rotatably supported rotary actuating elements formed as turn knobs 50, 52, 54 or turn sleeves and concentrically arranged about the rods 32, 34, 36. The rotation of the turn knobs 50, 52, 54 is detected in the units 56, 58, 60 and converted into drive signals for influencing the movement and/or the representation of the object, in particular the rotation of the object. Due to the separate rotary elements, the rotation of a graphical object can be entirely separated from the displacement, which may be desirable. With rotatable rods, a displacement of the rod most often also results in a slight rotation of the rod. This is no problem when the rotation of the rods is used, e.g., for a fine adjustment of the displacement.

Moreover, the input device 22' has a means 62 for manipulating the movement of the rods 32, 34, 36 and the turn knobs 50, 52, 54. This means 62 is controlled or activated depending on the position of the object on the screen 12. When the object is moved against an obstacle while actuating the rods 32, 34, 36, for example, the means 62 prevents a further movement of the respective rod or rods and turn knob or knobs. Thus, the representation on the screen is coupled with the freedom of movement of the rods 32, 34, 36 and the turn knobs 50, 52, 54. The means 62 may comprise drive means, e.g. stepper motors, cinematically coupled to the rods and turn knobs. While the braking device prevents further movement of the rods 32, 34, 36 and the turn knobs 50, 52, 54, the drive means is able to move the the rods 32, 34, 36 and the turn knobs 50, 52, 54 (back) when this is possible and desired for the given type of representation on the display.

It should be noted that an active movement and/or blocking of the rod-shaped actuating elements 32, 34, 26 in dependence on the position of the object within its environment represented on the display device can be realized independent of the presence of the position detector arrangement and, therefore, justifies legal protection by itself within the scope of the present invention.